and a general feeling of regret is felt over his early death, away from home and friends. The French geologist, M. Largeau, is at present endeavouring to penetrate into the Tuarej region from the north, and the interest previously centred on von Bary's investigations will now gather about his efforts.

In the spring of the present year we referred briefly to the attempt being made by Dr. J. M. Hildebrandt, under the auspices of the Berlin Academy of Sciences, to ascend the snow-covered summit of Mount Kenia. The question as to the permanent snow covering of the two equatorial mountains, Kenia and Kilimandscharo, has been a subject of so much controversy among geographers, that the results of this expedition have been looked for with great interest. It is with regret that we learn from a communication of Dr. Hildebrandt's, dated Suez, November 2, that he has been compelled to return, leaving the summit of Kenia still untrodden by the foot of a European. He left Mombassa on January 10 with forty attendants, and after two months of exhaustive travel amidst hostile tribes, reached Kitui, in Ukamba. Here, in full sight of Kenia, he was compelled to pause and retrace his footsteps, his followers utterly refusing to venture among the marauding tribes intervening between him and his journey's goal, and he himself being only saved by the swift application of an antidote from death by poison given by the natives. On reaching Zanzibar the physicians declared his health impaired to such an extent that restoration could only be hoped for in a more temperate clime. Dr. Hildebrandt has suffered unusually from the two invariable concomitants of the African explorer—sickness and the hostility of the aborigines, his two expeditions from Zanzibar in the spring and autumn of 1875 being both shortened and hampered by these causes.

Herr Schütt, a civil engineer, has been despatched by the German African Society to St. Paul de Loanda to undertake an expedition through the region lately traversed so successfully by the hunter, Dr. Pogge.

One of the effects of the war in the east appears to be the discovery in out-of-the-way towns in Russia, of gems of unsurpassed size and beauty, which doubtless have been jealously hoarded by their possessors, and only brought to light in times, like the present, of national necessity. Some of these gems have naturally found their way to this country; perhaps the most remarkable are—an aquamarine, far superior to anything before seen in England, weighing over six ounces and a half, without the slightest blemish, and of a deep sea-green tint; also a topaz rivalling that purchased for the Grand Mogul at Goa for 11,260*l*. These two remarkable gems were received from Moscow by Mr. Bryce M. Wright, Mineralogist, of Great Russell Street, the possessor of the unique suite of diamonds called the "Bryce Wright Diamonds," valued at 21,000*l*.

We are requested to state that in the abstract of Mr. Perkin's paper read at the meeting of the Chemical Society on November 1 the word "cumenyl" was, by a slip, written "cinnenyl" throughout the report.

The additions to the Zoological Society's Gardens during the past week include a Common Squirrel (*Sciurus vulgaris*), European, presented by Mr. T. Massey, F.Z.S.; a Greater Sulphur-Crested Cockatoo (*Cacatua galerita*), from Australia, presented by Mr. F. Lablache; a Radiated Tortoise (*Testudo radiata*) from Madagascar, presented by Mr. H. Harrison; two Red-backed Squirrel Monkeys (*Saimaris œrstedi*), two Black-handed Spider Monkeys (*Ateles melanochir*), a Derbian Opossum (*Didelphys derbianus*) from Central America, a Bonnet Monkey (*Macacus radiatus*) from India, a Rufous-vented Guan (*Penelope cristata*) from Costa Rica, deposited; a Bay Antelope (*Cephalophus dorsalis*) from West Africa, received in exchange.

THE LIBERTY OF SCIENCE IN THE MODERN STATE[1]

When the honourable request was addressed to me by our committee to deliver a lecture to the meeting upon this occasion, I asked myself whether I should not treat of a special department of the latest development of science, in accordance with that point of view to which I drew attention originally, and of which you were reminded by Prof. Klebs only the other day. But I decided this time to give expression to a more general want, principally because it seems to me that the time has come when a certain explanation must take place between science as we represent it and work in it, and general life as a whole, and because in the special history of the continental nations of Europe the moment is rapidly approaching when the mental fate of nations by decisions in the highest quarters may be determined perhaps for a long time to come.

It is not for the first time, gentlemen, that upon the occasion of a meeting of this Association I have been able, as a warning, to point out almost dramatic events happening in our neighbouring state. On a former occasion I could draw attention to occurrences which had just taken place beyond the Rhine, and which, however far they may apparently be removed from our task, yet concern the same contested domain after all, that namely upon which a decision must be made with regard to determining what position modern science is to occupy in the modern state. Let us be sincere—here we may perhaps be doubly so,—it is the question of ultramontanism and of orthodoxy, which moves us continually. I may say that I look forward with real fear to the events which will happen among our neighbours in the course of the next years. We here, at this moment, may look round with a certain pride and we may observe the course of things with a certain calmness. But to-day, when we are celebrating the fiftieth anniversary of this Association, it is certainly becoming to remember how great a change has taken place in Germany, and specially at Munich, since the days when Oken assembled German naturalists and physicians for the first time.

I would only refer shortly to two facts; they are well-known enough, but then they are also important enough to be mentioned again. The one is that when, in the year 1822, the handful of men who constituted the first meeting of the German Association of Naturalists met at Leipzig they thought it still so dangerous to hold a meeting of that description that it was really held in perfect secrecy. The names of the Austrian members could indeed be published only thirty-nine years later, viz., in 1861. The second fact which strikes us when we remember Oken is, that he, the valued and renowned teacher, the ornament of the Munich high school, died in exile in the same canton of Switzerland in which Ulrich von Hutten ended his life full of troubles and contests. Gentlemen, the bitter exile which oppressed the last years of Oken's life, which caused his death far away from those scenes where he had sacrificed the best powers of his life, this exile will remain the signature of the time which we have gone through. And as long as there is a German Association of Naturalists, we shall thankfully remember that this man bore all the signs of a martyr until the time of his death, we shall point him out as one of those who with their blood conquered and obtained for us the liberty of science.

Nowadays, gentlemen, it is easy to speak of the liberty of science in Germany; now we are perfectly secure even here, where, only a few decades back, the fear was great that a new change of things might perhaps produce the extreme reverse, and we can in all calmness discuss the highest and most difficult problems of life and the hereafter. The addresses which were delivered at the first and second general meetings certainly prove sufficiently that Munich is now a place which can bear to hear the representatives of science in the most perfect liberty. I was not able to listen to all these addresses, but I have since read those of Professors Haeckel and Nägeli, and I must say we cannot ask more than to be allowed to continue to discuss with such liberty.

If it were only a question of rejoicing over this possession I should indeed not have claimed your attention for that object. But, gentlemen, we have arrived at a point when it becomes necessary to investigate whether we may hope to retain securely for the future the possession which we actually enjoy. The fact that we are enabled to discuss, as we do to-day, is not a sufficient security that it will always remain so for one who, like myself, has had many years' experience of public life. Therefore I think that our efforts should not only tend to claim the attention of all for the moment, but I believe we ought also to ask ourselves what we are to do to maintain the present state of things. I will tell you at once, gentlemen, what I would represent to you as the chief result of my observations, what I would like to prove here principally. I would like to show that for the present we have nothing more to ask, but that on the contrary we have arrived at the point when we must make it our special task to render it possible, *through our moderation, through a certain resignation with regard to personal opinions and predilections* that the favourable disposition of the nation towards us, which we now enjoy, does not change to the contrary!

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[1] Address delivered at the Munich meeting of the German Association, by Prof. Rudolf Virchow, of Berlin.

In my opinion we are really in danger of doing harm to the future, by making use too amply of the liberty which the present state of things offers us, and I would warn you not to continue in the arbitrariness of personal speculation, which now claims prominence in many domains of natural science. The explanations which my predecessors have given you, those of Prof. Nägeli in particular, will yield a series of the most important points of view, with regard to the course and limits of natural knowledge, to all who read them, and it cannot be my task to repeat them. But I must point out in reference to them, and I would like to adduce a few practical instances from the experience of natural science, how great a difference there is between what we give out as real science in the strictest sense of the word, and for which alone we may in my opinion claim the totality of all those liberties which we may designate as liberty of science, or, if we express ourselves still more exactly, as *liberty of scientific teaching*,—and that larger domain, which belongs more to speculative expansion, which sets problems, and finds the tasks to which modern investigation is to be applied, and which anticipatively formulates a series of doctrines, which are still to be proved, and the truth of which must yet be found, but which in the mean time may be taught with a certain amount of probability, in order to fill certain gaps in knowledge. We must not forget that there is a limit between the speculative domain of natural science and that which is actually proved and perfectly determined. The demand is addressed to us that this limit shall be not only occasionally pointed out, but fixed with the greatest exactness, so that each single worker shall at all times be perfectly conscious of where the limit is drawn, and how far he may be requested to admit that what is taught is actual truth. That, gentlemen, is the problem which we have to work out *in ourselves*.

The practical questions which are connected with this, lie very near. It is evident that for whatever we consider to be secured scientific truth, we must demand the complete admission, into the scientific treasure of the nation. *This the nation must admit as part of itself*—it must consume and digest it, and continue to work at it. Just in this lies the double promotion which natural science offers to the nation:—On the one hand the material progress, that enormous progress which has been made in modern times. Everything which the steam engine, telegraphy, photography, chemical discoveries, the research into colours, &c., have produced, all this is essentially based on this—that we, the men of science, complete the doctrines entirely, and when they are perfectly complete and secure, so that we know with certainty that they are natural scientific truths, that we then give them to the nation at large; then others can work with them as well, and can create new things, of which formerly nobody had any idea, of which nobody dreamt, which come into the world as perfect novelties, and which reform the condition of society and of states. This is the material significance of our labours. The mental importance, on the other hand, is similar. If I present the nation with a certain scientific truth which is completely proved, to which not the least doubt attaches, if I demand that everybody shall convince himself of the correctness of this truth, that he shall assimilate it, that it shall become part of his thought, then I suppose as a matter of course, that his conception of things generally must be affected by it. Each essentially new truth of this kind must necessarily influence the whole method of conception of man, the *method of thinking*.

If, for instance, to refer to a case in point which lies near, we consider the progress which has been made during recent years with regard to the knowledge of the human eye, beginning at the time when the single component parts of the eye were first anatomically separated, when these single and anatomically separated parts were first examined microscopically and their different arrangement shown, down to the time when we gradually learned to know the vital qualities and the physiological functions of the different parts, until at last, by the discovery of the retina-purple (*Sehpurpur*) and of its photographic properties, a progress was made of which but a year ago we hardly had an idea, then it is evident that with each progressive step of this kind a certain part of optics, particularly the doctrine of vision, is determined and changed. By this we learn in a perfectly certain manner how the action of light takes place in the interior of the human body itself, and that it is quite an outside organ of the human body, not the brain, but the eye which experiences this action. We learn by it that this photographic process is not indeed a mental operation, but a chemical phenomenon, which occurs by the help of certain vital processes, and that in reality we do not see the external things, but their images in our eye. We are thus enabled to gain a new analytical fact for the knowledge of our relations to the world outside of us, and to separate more distinctly the purely mental part of vision from the purely material part. Thus a certain part of optics, and through it one of psychology, is entirely reformed. Chemistry now steps in to investigate questions which up to the present were entirely out of its range, particularly the highly important questions, What is retina-purple? What substance is this? How is it formed, how decomposed, and how again formed? The solution of these questions will not fail to open an entirely new field for investigation; let us hope that also on the field of technical photography we shall soon make some progress, that we shall learn how to produce many-coloured photographs. Thus a mixture of steps of progress is formed, which belong partly to the material and partly to the mental domain. And I therefore say, that with each true step of progress in natural knowledge a series of changes must necessarily take place in the internal relations of the human race as well as in the external ones, and nobody can prevent new knowledge from influencing him in a certain sense. Each new part of real knowledge works on in man, it produces new conceptions, new trains of thought, and nobody can avoid, after all, placing even the highest problems of the mind into a certain relation with natural phenomena.

But there is still another side of practical consideration which lies far nearer to us. Everywhere in the entire German Fatherland we are now occupied in remodelling educational affairs, in enlarging and developing them, and in determining their precise forms. The new Prussian educational law is on the threshhold of coming events. In all German states larger school-houses are being erected, new institutions are founded, the universities are enlarged, high schools and middle schools are established. At last the question arises, What is to be the principal tenor of what is taught? Where shall the school lead to? In what directions shall it work? If natural science demands, if we have been exerting ourselves for years to obtain an influence in our schools, if we demand that natural knowledge shall be admitted into education in a much larger measure, so that this fertile material be offered early to the youthful minds, in order to form the basis of a new conception, then we must indeed own that it is high time that we understood one another with regard to what we can and will demand. If Prof. Haeckel says that it is a question for pedagogues whether the theory of descent is now to form the basis of instruction, whether the plastidule soul is to be adopted as the basis of all considerations regarding mental phenomena, and whether the phylogeny of man is to be followed up into the lowest classes of the organic empire, and even beyond it up to spontaneous generation, then this is, in my opinion, a mere shifting of tasks. If the theory of descent is as certain as Prof. Haeckel thinks it is, then we must demand its admission into the school, and this demand is a necessary one. How could we imagine that a doctrine of such importance, which influences the conscience of everybody in so revolutionary a manner, which creates directly a sort of new religion, should not be entirely incorporated into the educational plan! How would it be possible to ignore such a revelation—as I may indeed call it—in our schools, and to kill it by silence as it were, or to leave the transmission of the greatest and most important steps of progress, which our conceptions have made in the whole century, to the option of the pedagogue? Indeed, gentlemen, that would be a resignation of the most severe kind, and in reality it would never be exercised. Every schoolmaster who might receive this doctrine in his mind would teach it as well, even unconsciously. How could he do otherwise? He would have to simulate altogether, he would have to rob himself at times of his own knowledge in the most artificial manner, in order not to show that he knew and recognised the theory of descent, and that he knew exactly how man has originated and whence he comes. If indeed he did not know where man goes to, yet he would at least believe that he knew for certain how in the course of æons the progressive series shaped itself. Therefore I say that if we really did not demand the admission of the theory of descent into the educational plan, this would yet be accomplished of its own accord.

We certainly should not forget, gentlemen, that what here we express, perhaps still with a certain timid reserve, is propagated by those outside with a confidence increased a thousand-fold. For instance, I have once pronounced the phrase—in opposition to the doctrine then reigning of the development of organic life from inorganic matter—that each cell had its origin in another cell, indeed at that time with special reference to pathology, and principally with regard to man himself. I may remark here that in both relations I still to-day consider this phrase a perfectly correct one. But when I had pronounced this doctrine and had formulated the origin of the cell from the cell, others were not wanting who extended this phrase not only in the organic world far beyond the limits for which I had intended it, but who put it down as generally valid even beyond the limits of organic life. I have received the most wonderful communications both from America and Europe, in which the whole of astronomy and geology were based upon the cellular theory, because it was thought impossible that something which was decisive for the life of organic nature upon this earth should not be equally applied to the heavenly bodies, which were said to be round bodies after all, and which had shaped themselves into globes and represented so many cells flying about in universal space and playing a part there similar to that of the cells in our body.

I cannot say that the authors of these communications were all decided fools and simpletons; on the contrary, from some of their explanations I gained the idea that many an otherwise educated man, who had studied much and finally attacked the problems of astronomy, could not understand that the utility of heavenly phenomena should be based upon something else than the utility of human organisation, so that he, in order to gain a monistic conception eventually arrived at the supposition that the heaven must also be an organism, that indeed the whole world must be an organism of useful arrangement, and that no other principle but that of the cells could apply to it. I cite this only in order to show what shape things take outside, how "theories" are enlarged, and how our own doctrines may return to us in a form fearful to ourselves. Now only imagine how the theory of descent may be shaped to-day in the head of a socialist!

Indeed, gentlemen, this may seem ridiculous to many, but it is very serious, and I only hope that the theory of descent may not bring all those horrors in our country which similar theories have actually brought to our neighbours. Anyhow this theory, if carried through to its consequences, has an extremely dangerous side and that the socialists have a certain notion of it already, you will doubtless have remarked. We must make this quite clear to ourselves.

Nevertheless the matter might be as dangerous as possible, the confederates might be as bad as they could be, and yet I say, from the moment when we are convinced that the theory of descent is a doctrine perfectly proved, so certain that we could swear by it, that we could say, thus it is,—from that moment we must not hesitate to introduce it into general life, transmit it not only to every educated person, but teach it to every child, make it the basis of our whole conception of the universe, of society, and of the state, and found our educational system upon it. This I consider a necessity.

In saying this I am not at all afraid of the reproach, which to my astonishment has made a great noise in my Prussian Fatherland, while I was absent in Russia, I mean the reproach of *half-knowledge*. Strange to say, it was one of our so-called liberal journals which asked the question whether the great faults of our time, and socialism in particular, were not based upon the diffusion of half-knowledge. With reference to this I would like to state here, in the midst of the Naturalists' meeting, that *all* human knowledge is only piece-work. All of us who call ourselves naturalists, only possess pieces of natural science; none of us is able to come here and represent each science with the same right, or participate in the discussions of any scientific section. On the contrary, it is just because they have developed themselves in a certain one-sided direction, that we esteem the special scientific men so highly. On the other fields we are all in half-knowledge as it were. Oh! that we could only succeed in diffusing this half-knowledge more and more, if we could succeed in causing at least the majority of educated persons to progress far enough to be able to survey the principal directions which the single departments of natural science are taking, and to follow their development without meeting difficulties too great to be overcome, so that they would at least be aware of the general progress of science, if, indeed, they were not acquainted, at every moment, with the totality of all single and special proofs. We do not get much further ourselves. I, for instance, have honestly tried during my time of life to obtain chemical knowledge; I have even worked in a laboratory, but I feel thoroughly incompetent to sit down at some chemical meeting without preparation, and to discuss modern chemistry in all directions. Nevertheless I am able to penetrate, after a time, so far into any chemical novelty that it does not strike me as incomprehensible. But I must always first acquire this understanding, I have not got it to start with; and when I want it again I must acquire it again. That which honours me is the *knowledge of my ignorance*. The most important part is that I know perfectly well what I do *not* know of chemistry. If I did not know that then of course I should always be wavering to and fro. But as I imagine that I am tolerably well aware what I do not know, I say to myself every time I am obliged to enter a domain which is still closed to me: "Now I must begin again to learn, now I must study afresh, now I must do as anybody does who enters the domain of science." The great error, which is equally shared by many educated people, consists in not remembering that with the enormous extent of natural science and with the inexhaustible quantity of detailed material, it is impossible for any single person alive to command the totality of all these details. That we get far enough to know the *foundations* of natural science and the gaps which exist in our own knowledge, so that every time we find a gap of this kind we say to ourselves,—"Now you enter a domain which is unknown to you,"—that is what we must arrive at. If everybody was only sufficiently aware of this, many a one would beat his breast and own that it is a dangerous thing to draw general conclusions with regard to the history of all things when one is not even entirely master of the material from which these conclusions are to be drawn.

(*To be continued.*)

UNIVERSITY AND EDUCATIONAL INTELLIGENCE

CAMBRIDGE.—This term has witnessed the election of two new Natural Science fellows. Mr. A. M. Marshall, Senior in the Tripos of 1874, has been elected at his own College, St. John's. His able papers on Embryology have been an important addition to the researches which are making the British school again famous in this subject, and he is the first Doctor of Science in Comparative Anatomy in the University of London. Two of the newly-elected fellows of St. John's are taking to Medicine, viz., Dr. Marshall and Mr. McAlister, the last Senior Wrangler. At Trinity the open fellowship has been adjudged for the first time to a non-member of the College, Mr. J. N. Langley, B.A., of St. John's, whose services as Demonstrator of Physiology to Dr. Foster are most highly appreciated, while his originality and perseverance in research will, before long, be much more widely known than at present. I understand that the aid of Prof. Huxley was called in, giving the highest guarantee to the examination in Biology, and that several candidates showed themselves in every way worthy of a fellowship, especially in the original memoirs which were sent in before the examination.

The new buildings for anatomy and physiology are advancing to completion and are partially occupied, Mr. Balfour's two practical courses of Comparative Anatomy being accommodated in them. Dr. Foster will transfer much of his work here after Christmas. The new buildings will be almost too small as soon as completed, for Dr. Foster has fifty men and several ladies working in his elementary classes this term, a very large number when it is considered that this is voluntary and not prescribed work. It is but a just tribute to Dr. Foster's rare value as a teacher who makes his students think, who sacrifices his time most indefatigably for their interests, and who cultivates the powers of investigation developing in his pupils with all the care of a parent. Instead of engrossing authority to himself, he sets his senior pupils to lecture on the subjects they make a special study; thus during the present winter the advanced class will receive lectures from Dr. Gaskell, Mr. Langley, and Mr. Lea. Mr. Vines has returned from working in Germany